required. Nonabsorbable sutures should be used for an episiotomy in women who are insensate in the perineum or spend their day sitting in a wheelchair. The wound should be examined frequently for breakdown.

The medical aspects of disability should not take precedence over the focus of pregnancy. Nightmares—for example, that a baby may be born without a spinal cord—can be relieved by providing information and reassurance that an acquired disability such as spinal cord injury cannot be transmitted to the baby. Through planning and organization, the woman's self-confidence can be affirmed and her abilities enhanced for the care of a dependent infant.

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Birth Brachial Plexus Injury

BIRTH BRACHIAL PLEXUS INJURY occurs in approximately 1 per 1,000 live births in the United States. The most frequently involved level of lesion is C5-6, causing Erb's palsy. The next most frequent is a combined palsy that includes C-7. Klumpke's paralysis, involving C-8 to T-1, is the least frequently seen. Most infants are large and born to multiparous mothers. Most (50% to 90%) of these lesions resolve spontaneously.

Evaluating a case of birth brachial plexus palsy can include physical, electrodiagnostic, and radiographic examinations. Radiographic examinations include x-ray films of the humerus and clavicle to exclude fractures, with controversy over the benefit of magnetic resonance imaging or computed tomography. Electrodiagnosis consists of nerve conduction studies, both motor and sensory, electromyography, and possibly somatosensory evoked potentials. Which muscles and nerves to examine should be carefully planned, depending on the areas of deficit. The somatosensory evoked potentials are done infrequently because infants must be sedated for the study. Instead, the proximal portions of the nerve are studied using F waves and H reflexes in nerve conduction studies. In an insensate arm, the presence of sensory nerve action potentials indicates an avulsion and that the lesion is proximal to the dorsal root ganglion. Fibrillations in paraspinal muscles may also indicate a preganglionic lesion, as these muscles are innervated by the posterior primary rami (as opposed to anterior primary rami innervating the arm). Fibrillations are not always present, however, and the overlap of levels of innervation also makes interpretation uncertain. The physical examination is done by observing any spontaneous use of the arm, positioning, the use of primitive reflexes, and positive and negative stimuli (offering candy and sharp or dull testing, respectively).

The initial treatment approach begins with occupational therapy. Parents are immediately taught range-of-motion exercises and maximal positioning of the involved upper extremity. Range of motion is used for maintaining mobility of the joints and to avoid contractures. This is of utmost importance whether the patient has spontaneous resolution of symptoms or if there is a need for surgical therapy in the future. Range-of-motion exercises in patients with Erb's palsy particularly emphasize abduction and external rotation of the shoulder along with supination of the forearm because of the classic adducted, internally rotated position of the arm with pronation of the forearm. In addition, extension and flexion of the elbow are done. In an infant with Klumpke's paralysis, the emphasis is on wrist and finger exercises and elbow extension range of motion. Splinting is used if there is severe wrist drop, particularly with unopposed strong wrist flexor muscles. Many infants, particularly babies with an insensate limb, require various forms of stimulation to increase the awareness of the involved extremity. In such a case, a bracelet with bells or other noise-making objects are frequently used so that the baby can "hear" the presence of the involved arm. Small toys may also be attached to a bracelet on that arm to improve attention to the limb.

It is important that any active motor function present in the involved extremity be used to its fullest. Parents are taught by a therapist how to enhance any motor function present in the limb, which varies depending on the level of injury. In a C5-6 injury, if only the hand has intact motor function, the arm must be positioned so that the hand can be actively used. If the proximal portion of the arm is functioning, but not the hand, then the child may use the arm for carrying large objects such as a stuffed animal or a beach ball, using the involved or both extremities. It is important to have the child perform these activities so that he or she learns to do some actions using both extremities and does not go through early developmental stages learning to do everything with one hand. If this occurs, it is extremely difficult to get the child to use both hands in the future, even if there is excellent motor and sensory return.

Problem areas noted in children with birth brachial plexus injury include the classic internal rotation and adducted contracted position of the arm of a child with C5-6 palsy who has had no range-of-motion exercises. With these exercises, there is a risk of dislocating the shoulder due to the shallow glenoid cavity and the minimal musculature present to hold the humerus into the shoulder. With range-of-motion exercises of the forearm to supinate, there is also a risk of dislocating the radial head. With no therapy or exercises, there may be contractures, muscle atrophy, and possible lack of use of the extremity, even if there is future motor return. Problems may include cosmetic problems with contractures, limb length discrepancy with the involved arm being shorter than the other, and winging of the scapula, although this may be less no-

ticeable as a child ages. Skin ulcerations may occur in an insensate limb from injury or even from children biting themselves. Pain is not usually present, unlike with acquired brachial plexus injuries in adults.

In babies without spontaneous resolution of their brachial plexus palsy, a surgical exploration can be considered after 4 months of age. Opinions of the optimal time for surgical interventions vary from 3 months to 9 months of age. The brachial plexus is surgically exposed, electrodiagnostic studies are done (somatosensory evoked potentials and nerve conduction studies), and then a neurolysis (removing scar tissue on the nerve) and, in some children, a nerve graft are done. Improvements are noted from six months to two years after the operation. In children older than 3 years who have substantial deficits, tendon or muscle transfers can be done to improve function. Tendon transfers are most commonly used about the wrist. Muscle transfers can be used to provide elbow flexion or extension and shoulder abduction and external rotation. The child must be able to cooperate with intensive therapy after a muscle transfer to learn to use the new muscle function.

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